National Ignition Facility & Photon Science

NIF & SCIENCE

The National Ignition Facility (NIF) will have many uses besides its primary mission in the U.S. Department of Energy's Stockpile Stewardship Program. It will provide a broad array of applications to basic science and will also play an important role in the development of commercial fusion energy.

Basic Science

Basic science involves understanding the universe in fundamental ways, usually at a very small scale. There are many ways in which NIF may be used to assist researchers, and likely many more that will only be evident after NIF begins operation. Below are summaries of five applications of NIF to basic science.

Astrophysics—NIF will bring the study of stars and their environments into the laboratory, with the potential to greatly expand our understanding of the nature and origin of the universe.

Hydrodynamics—NIF will create conditions more extreme than can be produced in wind tunnels or shock tubes, enhancing the study of fluid motion and fluid-boundary properties.

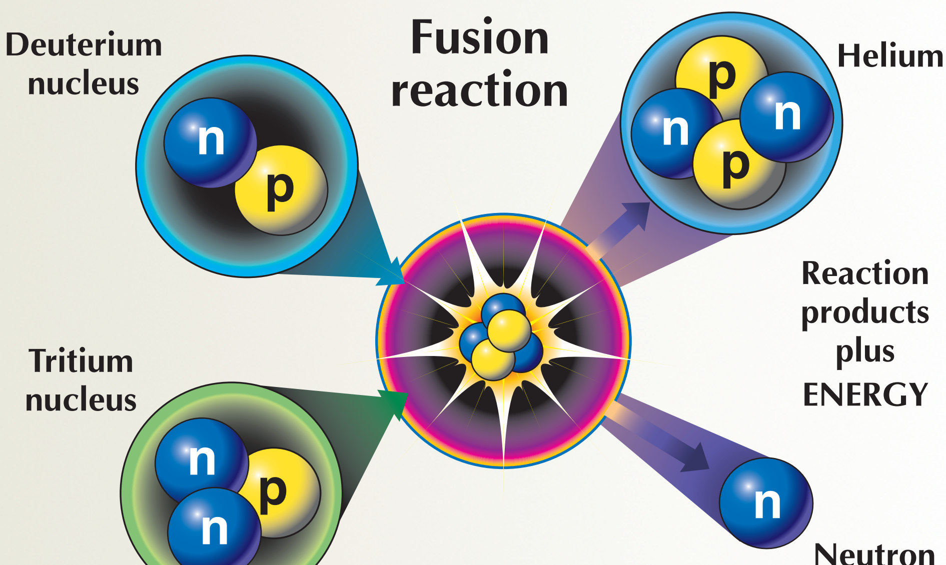
Material Properties—NIF's capabilities for studying condensed matter physics at extreme conditions of temperature and pressure will make it an important new tool in the study of high-energy-density physics.

Plasma Physics—Plasma, the fourth state of matter, is the predominant state of matter in the universe (the other three are solid, liquid, and gas); NIF will advance our understanding of plasmas and their properties.

Radiation Sources—NIF will allow researchers to convert laser energy to a wide variety of x-ray and particle sources needed to address several important physics questions.

Fusion Energy

NIF will have the ability to demonstrate fusion ignition and energy gain, two important milestones in the scientific pursuit of fusion energy. Ignition is when the fuel inside a fusion fuel capsule explodes at its center, igniting a chain reaction releasing the fuel's latent energy. Energy gain is when the energy released by the fusion reaction is greater than the energy used to produce the reaction. NIF will be the first facility to demonstrate these capabilities.



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Fusion energy is not the same as fission energy; the figures on the reverse side and below show how the processes differ. Within the atoms of any element, smaller particles in the nucleus (neutrons and protons) are held together by binding energy. When nuclei are either fused together (nuclear fusion) or split apart (nuclear fission), the rearrangement of those particles releases large amounts of that binding energy.

Fission power plants are already in operation throughout the world. Fusion power plants would be much cleaner and would be fueled by a renewable source—water—but the science needed to make fusion viable in a commercial power plant is not yet complete. NIF is a significant step towards reaching that scientific goal.